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9. Почему в кукольных мультфильмах маленькая глубина резкости и причём тут лунный ровер?

8-9 minutes

This article is about shooting dolls, about the moon and about depth of field - depth of field.

If you carefully review your favorite puppet cartoons from childhood ("Cheburashka", "Dunno", "Mitten", "The Wizard of the Emerald City", etc.), you will notice a small depth of field in many shots. If the decoration goes deep, then already at a small distance the objects in the background look blurry, out of focus. The same thing happens with the foreground - it goes out of focus.

A shot from the "Cheburashka" puppet cartoon. In sharpness - only two figures, background and foreground go beyond the boundaries of sharpness.

Now almost everyone knows that the shallow depth of field is due to the fact that the dolls are shot at close range, about 1-1.5 meters.

If we take a photo of a small copy of a car (radio-controlled model) from a close distance (less than a meter), then the rear of the car will be out of focus. And we will immediately determine that in front of us is a toy.

Radio-controlled model, small copy.

Why, then, when NASA uses radio-controlled models with dolls, posing as astronauts on a lunar rover (as, for example, in the Apollo 16 mission), we do not see blur in the background or in the foreground? This question especially worries the defenders of NASA's lies, they think that the absence of blur in the frame allegedly may indicate that the frame is not a reduced copy, but a real full-size rover with an astronaut.

This RC model doll rides through the sandbox and is passed off by NASA as an astronaut on the moon. The Apollo 16 mission.

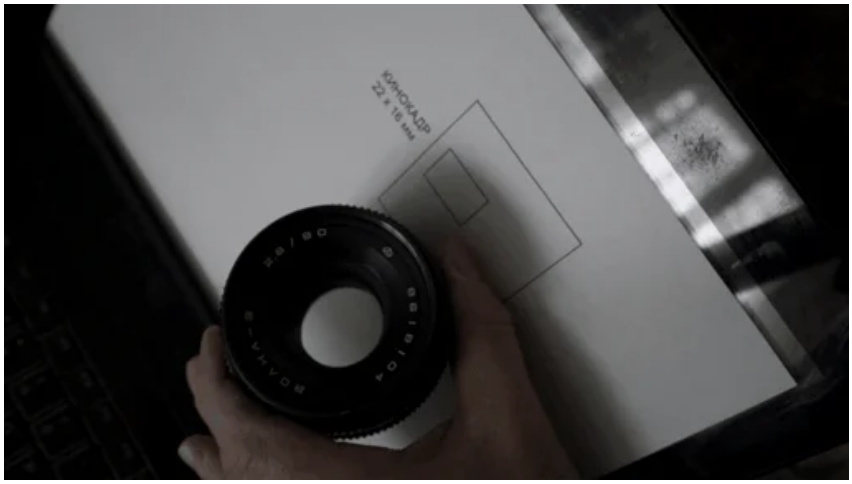
As a teacher, I cannot ignore this question addressed to me, and I am happy to answer it. The teacher's task is to explain complex things in simple words.

So, in order. In addition to the **distance** at which we focus, the depth of field (DOF) depends on two more parameters: the **focal length of the lens** and the **aperture value** .

The focal length of the lens is primarily determined by the aspect ratio at which the picture is taken. Therefore, let's "go through" the formats.

According to NASA legend, all the "lunar" photographs were taken with a medium format "Hasselblad" with a square frame. For all terrestrial photographers, the frame size on such cameras is 58x58 mm, or, more simply, 6x6 cm. The frame size is exactly the same on the domestic medium format cameras "Kiev-88" and "Salut", since this is the standard. But for the "lunar" camera, the frame size was reduced to 53x53 mm (a little "cropped").

For the 6x6 cm format (this is what all photographers call this format) there is a "normal" (standard) lens with a focal length of 80 mm. This means that the distance from the optical center of the lens to the sharp image will be 80mm. At this distance, you need to move the lens away from the sheet of paper to get a sharp image of a distant object.



The "80 mm" lens projects the image onto a sheet, where frames for a medium format frame (58x58 mm) and a film frame (22x16 mm) are applied.

On the sheet of paper where the image is projected, there are frames of a medium-format square frame, this is 58 x 58 mm, and inside there is a rectangle, the dimensions of which are equal to the size of a frame in a movie, 22 x 16 mm. For medium format, an "80 mm" lens will give one angular field of view, but for cinema format, when shooting with this lens, the angle of coverage will be sharply reduced. For a cine lens to cover the same field of view as a medium format camera, its **focal length must be equal to the diagonal of the frame** . A lens with this focal length will be referred to as "normal".

For medium format, 80mm lens will be considered "normal". "60mm" for Hasselblad is already a wide-angle lens.

The camera, which shoots on 13x18 cm plates, will be equipped with a lens with a focal length of 210 mm, since this is the diagonal of the frame.

FKD camera 13x18 cm. View from the frosted glass side.

And the stretching of the bellows during normal shooting on the PCD will be about 20 cm.

FKD camera 13x18 cm.

For a small-format camera that shoots on 35 mm film, a lens with a focal length of 40-50 mm will be considered "normal", since the diagonal of a 36x24 mm photo frame is 42 mm.

When we talk about cinema, the area of the frame is 2 times smaller than in the photo, 22x16 mm. The diagonal of the frame is only 27 mm. Therefore, a "normal" lens will be considered one with a focal length of 28-35 mm.

When in a puppet cartoon you need to get a medium or close-up, then a lens with a focal length of 75 mm is used. For cinema format, these are long-focus optics. From the "Handbook of the cameraman" you can find out that when shooting from a distance of 1 meter, the size of the picture plane will be 27 x 20 cm, and the depth of field (with an aperture of 5.6) will be only 5 cm, from 0.97 to 1.03 m. And if you need to shoot at a height not 20 cm, but larger, you have to change the lens to a longer one.

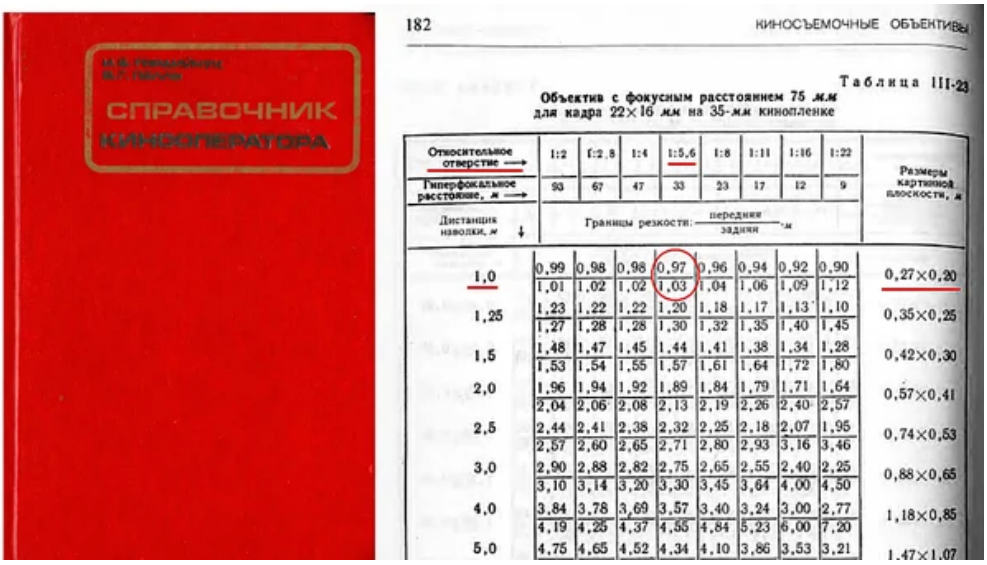


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Таблица III-23

Объектив с фокусным расстоянием 75 мм для кадра 22×16 мм на 35-мм кинопленке

Относительное отверстие →	1:2	1:2.8	1:4	1:5.6	1:8	1:11	1:16	1:22	Размеры картинной плоскости, м
Гиперфокальное расстояние, м →	93	67	47	33	23	17	12	9	
Дистанция наводки, м ↓	Границы резкости: передняя / задняя, м								
1,0	0,99	0,98	0,98	0,97	0,96	0,94	0,92	0,90	0,27×0,20
	1,01	1,02	1,02	1,03	1,04	1,06	1,09	1,12	
1,25	1,23	1,22	1,22	1,20	1,18	1,17	1,13	1,10	0,35×0,25
	1,27	1,28	1,28	1,30	1,32	1,35	1,40	1,45	
1,5	1,48	1,47	1,45	1,44	1,41	1,38	1,34	1,28	0,42×0,30
	1,53	1,54	1,55	1,57	1,61	1,64	1,72	1,80	
2,0	1,96	1,94	1,92	1,89	1,84	1,79	1,71	1,64	0,57×0,41
	2,04	2,06	2,08	2,13	2,19	2,26	2,40	2,57	
2,5	2,44	2,41	2,38	2,32	2,25	2,18	2,07	1,95	0,74×0,53
	2,57	2,60	2,65	2,71	2,80	2,93	3,16	3,46	
3,0	2,90	2,88	2,82	2,75	2,65	2,55	2,40	2,25	0,88×0,65
	3,10	3,14	3,20	3,30	3,45	3,64	4,00	4,50	
4,0	3,84	3,78	3,69	3,57	3,40	3,24	3,00	2,77	1,18×0,85
	4,19	4,25	4,37	4,55	4,84	5,23	6,00	7,20	
5,0	4,75	4,65	4,52	4,34	4,10	3,86	3,53	3,21	1,47×1,07

Depth of field table for 75mm lens from the Cinematographer's Handbook.

For filming of puppet cartoons at the Soyuzmultfilm studio, they used a Rodina movie camera with a frame-by-frame motor (mounted on the right side). The camera had a forward and backward motion, it could do blackouts and sags right on the shoot - the shutter had a variable opening angle, from 160 to 0 degrees.Such a movie camera can be seen in the Soyuzmultfilm Museum.

Movie camera "Rodina". To the left of the lens on the side wall is a lever for changing the opening angle of the shutter, with a semicircular scale.

When shooting the cartoon "Mitten", a variable focal length lens was used.

Cartoon "Mitten". The background is out of focus.

It is quite possible that it was "Photon" 37-140 mm. Let me remind you that the diagonal of the frame and the "normal" lens are 27-28 mm, and here the minimum focal length starts from 37 mm.

Zoom lens "Photon", 37-140 mm.

To obtain close-ups, almost maximum zoom was used.

Cartoon "Mitten", close-up. The background is completely blurred.

We see that cartoons were mostly filmed with long-focus optics.

And what optics was used to shoot the rover's passage in the Apollo 16 mission? NASA claims it was a 16mm Maurer movie camera, and we agree that the passage was indeed filmed with a 16mm movie camera.

16mm movie camera Maurer.

The frame size on 16 mm film is 10.26 x 7.49 mm, i.e. the width of the frame is only 1 cm. And the diagonal of the frame is 12.5 mm (or 1/2 inch).

On 16 mm film, the width of the film frame is approximately 1 cm.

Therefore, a lens with a focal length of 12 mm will be considered "normal" for a 16mm format.

"Normal" lens for a 16 mm movie camera, a focal length of 12 mm.

And the rover passes were filmed with a 10mm wide-angle lens at an aperture of 1:11.

We look at the Handbook of the cameraman:

Таблица III-27

Объектив с фокусным расстоянием 10 *мм*
для кадра 10,05×7,45 *мм* на 16-*мм* кинопленке

Относительное отверстие →	1:2	1:2,8	1:4	1:5,6	1:8	1:11	1:16	1:22	Размеры картинной плоскости, *м*
Гиперфокальное расстояние, *м* →	3,3	2,4	1,7	1,2	0,8	0,6	0,4	0,3	
Дистанция наводки, *м* ↓	Границы резкости: передняя / задняя, *м*								
0,75	0,61 / 0,97	0,57 / 1,09	0,52 / 1,34	0,46 / 2,0	0,39 / 12,0	0,33 / ∞	0,26 / ∞	0,22 / ∞	0,75×0,56
1,0	0,77 / 1,43	0,71 / 1,72	0,63 / 2,43	0,55 / 6,0	0,44 / ∞	0,38 / ∞	0,29 / ∞	0,23 / ∞	1,0×0,74
1,25	0,91 / 2,01	0,82 / 2,62	0,72 / 4,7	0,61 / ∞	0,49 / ∞	0,41 / ∞	0,30 / ∞	0,24 / ∞	1,25×0,93
1,5	1,03 / 2,76	0,92 / 4,0	0,80 / 12,7	0,67 / ∞	0,52 / ∞	0,43 / ∞	0,32 / ∞	0,25 / ∞	1,50×1,14
2,0	1,25 / 5,08	1,09 / 12,0	0,92 / ∞	0,75 / ∞	0,57 / ∞	0,46 / ∞	0,33 / ∞	0,26 / ∞	2,0×1,49
2,5	1,42 / 10,3	1,22 / ∞	1,01 / ∞	0,81 / ∞	0,61 / ∞	0,48 / ∞	0,34 / ∞	0,27 / ∞	2,50×1,86
3,0	1,57 / 33,0	1,33 / ∞	1,08 / ∞	0,86 / ∞	0,63 / ∞	0,50 / ∞	0,35 / ∞	0,27 / ∞	3,0×2,24
4,0	1,81 / ∞	1,50 / ∞	1,19 / ∞	0,92 / ∞	0,67 / ∞	0,52 / ∞	0,36 / ∞	0,28 / ∞	4,0×2,98
5,0	1,98 / ∞	1,62 / ∞	1,27 / ∞	0,97 / ∞	0,69 / ∞	0,54 / ∞	0,37 / ∞	0,28 / ∞	5,0×3,72

Depth of field for "10 mm" lens.

When focusing the lens at 0.75m, the sharpness will be from 33cm to infinity. We know that **the shorter the focal length of the lens, the greater the depth of field** .

The table of pickup distances in the "Handbook of the Cinematographer" starts at 0.75 m. If you use another, spreadsheet, With a DOF calculator , you can easily translate the aiming distance to 0.6 or even 0.5 meters. And then the front edge of sharpness will start at 25 cm.

It should be borne in mind that the aiming distance is measured not from the front lens of the objective, but from the plane of the film (or matrix). So in 20 centimeters from the lens the sharpness will already be.

So, there is nothing surprising that in the frames of the "lunar" rover's passage (although they were shot using a doll and a model), there is a large depth of field. The shooting was carried out with a highly apertured wide-angle lens on narrow film with a small frame size.

*

Cameraman L. Konovalov was with you

Until next time!